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UPDATED POPULATION AND HABITAT COMMENTS ABOUT THE REPTILES OF THE SWAN ISLANDS, HONDURAS

JAMES R. MCCRANIE,[1] ALEXIS HARRISON,[2] AND LEONARDO VALDÉS ORELLANA[3]

ABSTRACT. We discuss the results of a recent trip to the isolated Swan Islands, Honduras. We include habitat notes for each of the reptilian species we encountered. Also, we compare nine of the 13 reptilian species previously reported from these islands with the only previous reptilian species list that contains natural history notes. Comparisons between our 2012 experiences and those of a 1912 trip demonstrate that the following changes have occurred in the past century: three lizard species have been introduced by humans; two of the four island endemic reptilian species remain common, as they were in 1912; one endemic lizard species appears to have declined drastically in numbers; and the single endemic snake species remains as poorly known now as it was in 1912.

Key words: Annotated Species List, Swan Islands, Caribbean Sea, Environmental Notes, Reptilia

INTRODUCTION

The reptilian species known from the Swan Islands (usually not including the marine turtles) have been listed several times, most recently by Powell and Henderson (2012), who failed to mention the two species of *Hemidactylus* recently introduced there (Sandoval et al., 2007; Köhler and Ferrari, 2011). Many of the existing lists have erroneously included a *Cnemidophorus* from the Swan Islands (last by Savage, 2002). McCranie (2017) discussed the situation regarding the *Cnemidophorus* from these islands.

Almost all authors who have discussed the reptilian species of the Swan Islands do not give any information about habitats of the resident species, with the exception of Lister (1976a,1976b). Also, besides Lister, none of those authors had visited those islands, or apparently even examined specimens. The main exception with regard to habitat information and examination of specimens is Barbour (1914), although he did not visit the Swan Islands himself. Barbour (1914) described four new species endemic to the Swan Islands, all of which are considered valid herein. Barbour (1914) relied on the field notes of G. Nelson, the original collector of those species, to write some brief but excellent field notes about three of the four species.

The Honduran Swan Islands consist of two still-forested islands, at least partially forested in the case of Big Swan Island, located in the Caribbean Sea about 160 km to 180 km north of the northeastern Honduran mainland (Keith, 1985; Morgan, 1985) and about 350 km southwest of Grand Cayman Island, the closest non-Honduran island, making them "among the most isolated islands of the West Indies" (Morgan, 1985: 42). Aceituno and Medina (2008) erroneously wrote that the Swan Islands were 250 km from the Honduran mainland. The two islands that make up this island group are called Big Swan Island and Little Swan Island herein. The Swan Islands group is also called the Islas del Cisne or Islas

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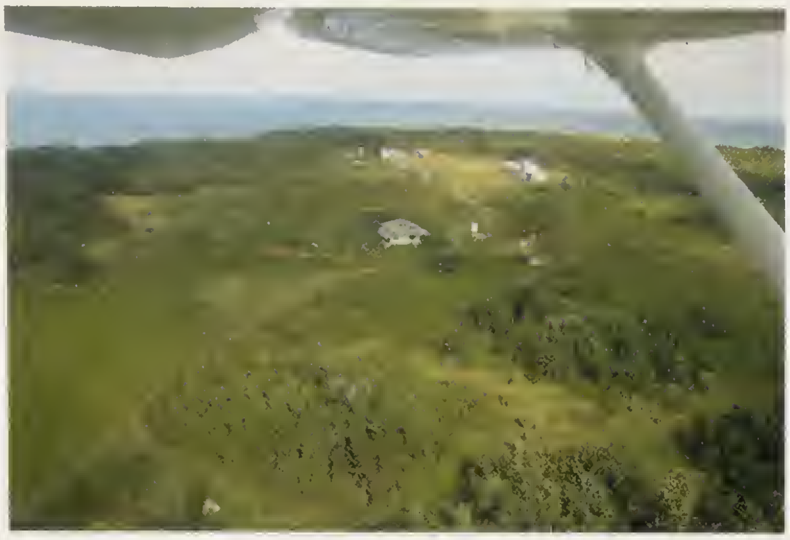


Figure 1. The Honduran Naval Base and nearby abandoned structures on Big Swan Island, as seen from an airplane. Photo taken on 9 December 2012 by Alexis Harrison (A. H.)

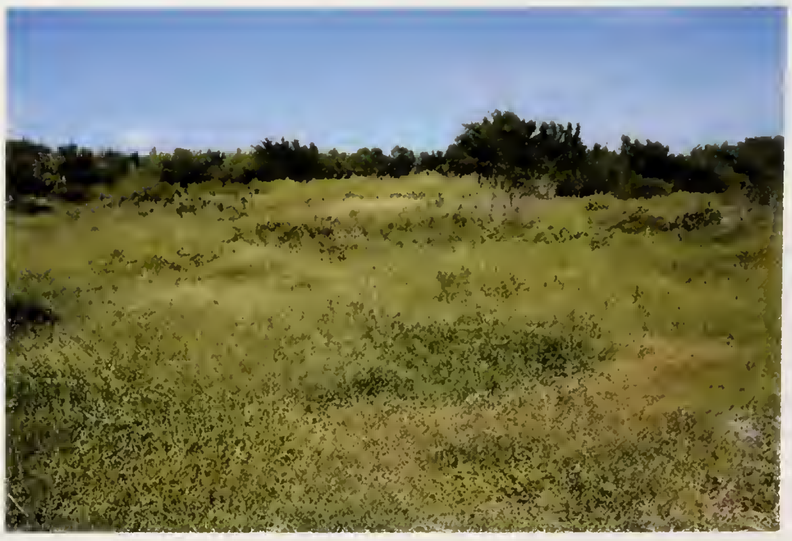


Figure 2. Edge of airstrip and adjacent forest on Big Swan Island. Photo taken on 9 December 2012 by A. H.

Santanilla on some maps and by some inhabitants of northeastern Honduras. The Swan Islands have had a long and conflicted history and were claimed by the U.S. until the U.S. dropped its claim during 1972 (see Weigel, 1973). The Swan Islands are part of the department of Gracias a Dios (Atlas Geográfico 2006), not the Islas de la Bahía, as stated on the Wikipedia website (http://en.wikipedia.org/wiki/Great_Swan_Island; last downloaded 4 June 2016). Although several reptiles have been reported from both islands, no amphibians occur on either island.

No evidence indicates that the Swan Islands were ever connected with the mainland or any other West Indian island (Morgan, 1985, 1989). Big Swan has a land area of about 3 km^2 and Little Swan about 2 km^2 (Morgan, 1985, 1989), although Powell and Henderson (2012) reported a land area of 5.5 km^2 for Big Swan and 2.5 km^2 for Little Swan. Some researchers consider a third island, called Cayo del Pájaro Bobo (Booby Cay), to be an island in the Islas del Cisne chain, but this tiny cay is too small to constitute an island (land area less than 0.1 km^2) and is only slightly separated from Big Swan. The highest elevation on Big Swan is only 14 m and that on Little Swan only 20 m (Keith, 1985). Morgan (1985, 1989) gave the coordinates for Big Swan Island as 17°24′N, 83°56′W. Our readings with a handheld global positioning system from the center of the Naval Base Headquarters on Big Swan were 17°24.333′N, 83°56.510′W (WGS84). The elevation was recorded as 8 m. Met Office (1978) reported that the average maximum daily temperature for the period from 1917 to 1936 (some data incomplete) was 86°F and the average minimum daily temperature was 75°F. In general, a dry season occurs from January to May, and a wet season from June to December (Weigel, 1973). Weigel (1973) also provided much information on the history of human presence on Big Swan. Little Swan is uninhabitable to humans and their domesticated animals because of its rocky cliffs that stretch from shoreline to shoreline. McCranie (2011: 26–27) classified the forests on these islands as "Lowland Dry Forest, West Indian Subregion." Figures 1–8 show some of the habitat on the Swan Islands during December 2012, whereas Figure 9 shows the field group.

MATERIALS AND METHODS

We conducted fieldwork and collected tissues and some specimens on Big Swan Island from 9 to 13 December 2012 and during the morning of 12 December on Little Swan Island. We targeted all reptilian species on the islands, with A. H. primarily focused on anoles. Powell and Henderson (2012) listed eight reptile species from the Swan Islands. We were able to collect and

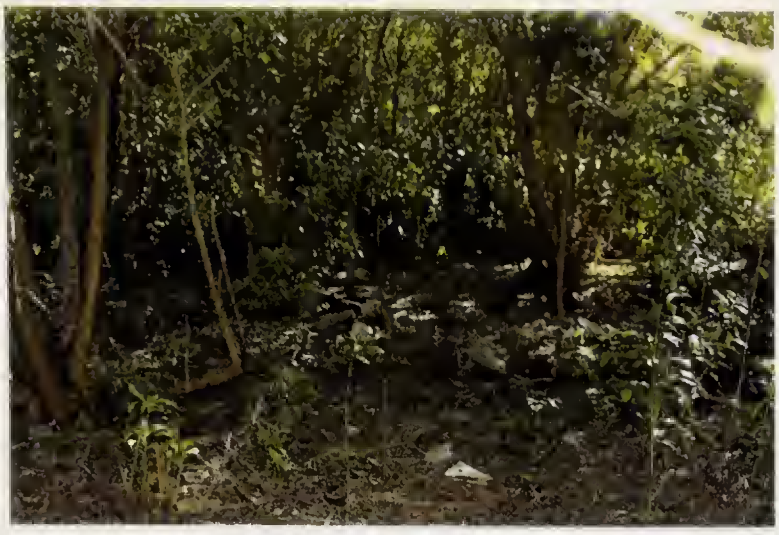


Figure 3. Interior forest on Big Swan Island. Photo taken on 14 December 2012 by Leonardo Valdés Orellana (L. V. O.)

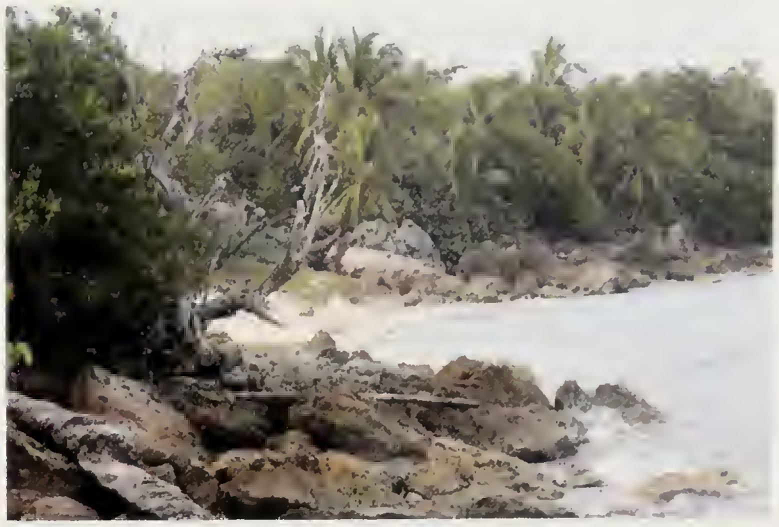


Figure 5. Coastal forest on northern side of Big Swan Island. Photo taken during December 2012 by A. H.

closely observe six of the species, only lacking the extirpated *Ameiva* and *Cubophis brooksi,* which is endemic to Little Swan Island. Two introduced species of *Hemidactylus* were overlooked by Powell and Henderson (2012). Those two species of *Hemidactylus* were first collected during 2007 (Sandoval et al., 2007; Köhler and Ferrari, 2011, as *H. brookii* Gray, 1845).

RESULTS

Lizards

Gekkonoidea
Gekkonidae

Hemidactylus frenatus Schlegel (1836 IN A. M. C. Duméril and Bibron)

This introduced house gecko (Fig. 10) has rapidly become abundant in all edificarian or non edificarian situations on Big Swan Island, including walls associated with the naval base and in seminatural situations throughout Big Swan Island. It appears to be rapidly eliminating the native and endemic *Aristelliger nelsoni* on Big Swan (see below) despite being first collected on Big Swan in 2007 (Sandoval et al., 2007). Similar elimination of other Honduran endemic, arboreal gekkotan lizards by *H. frenatus* has been documented on the Honduran Bay Islands (McCranie, 2017) and on islands in the Golfo de Fonseca in southern Honduras (McCranie and Gutsche, 2016; also see Powell, 2003 regarding that suspicion on Isla de Utila, Honduras). We collected a series of these nonnative geckos on Big Swan and deposited these

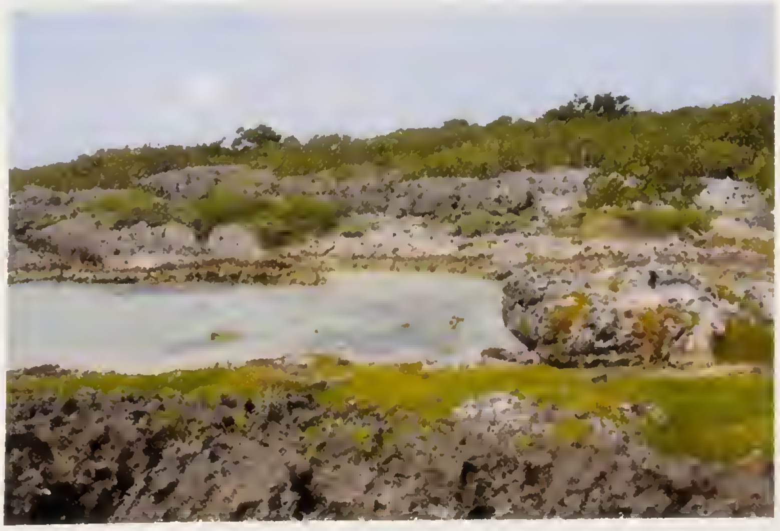


Figure 4. Coastal forest on southwestern side of Big Swan Island. Photo taken on 17 December 2012 by L. V. O.

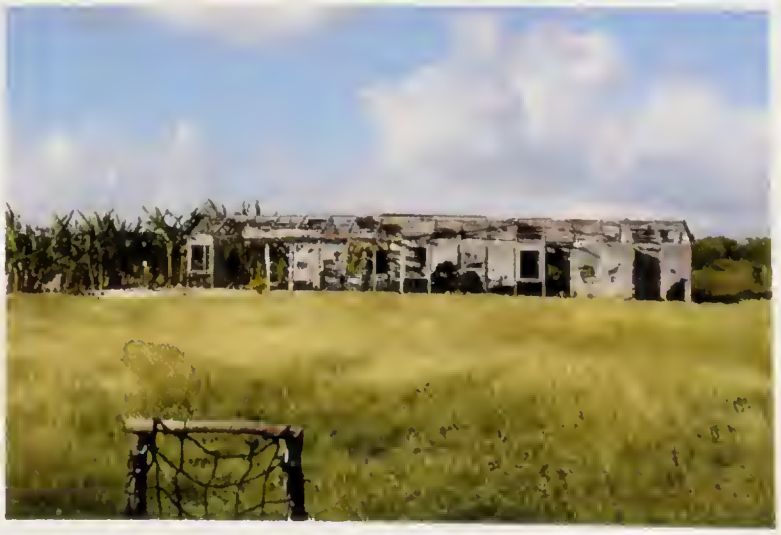


Figure 6. Damaged structure from U.S. time on Big Swan Island. Photo taken on 14 December 2012 by L. V. O.

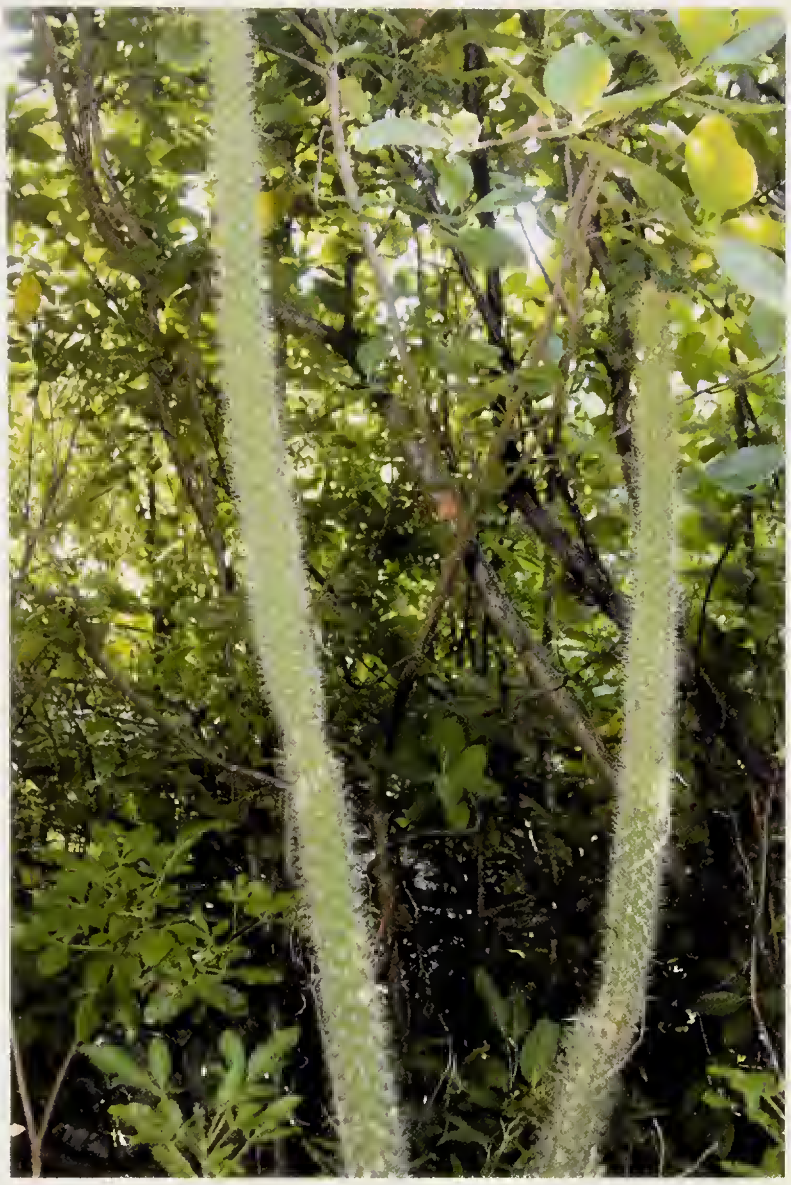


Figure 7. Interior forest on Little Swan Island. Photo taken on 12 December 2012 by L. V. O.

specimens in the Museum of Comparative Zoology collections (MCZ R-191070, 191124, 191127–30, 191136, 191140–41, 191147–54).

Hemidactylus mabouia (Moreau de Jonnès, 1818)

This is another introduced house gecko (Fig. 11), also first found on Big Swan during 2007. As is the case in other Honduran localities (McCranie, 2017), *H. mabouia* was apparently being replaced by *H. frenatus* by the time of our 2012 visit. The single *H. mabouia* we collected (MCZ R-192116) was found on the wall of an old building near the naval base. We note that both *H. frenatus* and *H. mabouia* were erroneously reported from Big Swan as *H. brookii* by Köhler and Ferrari (2011).

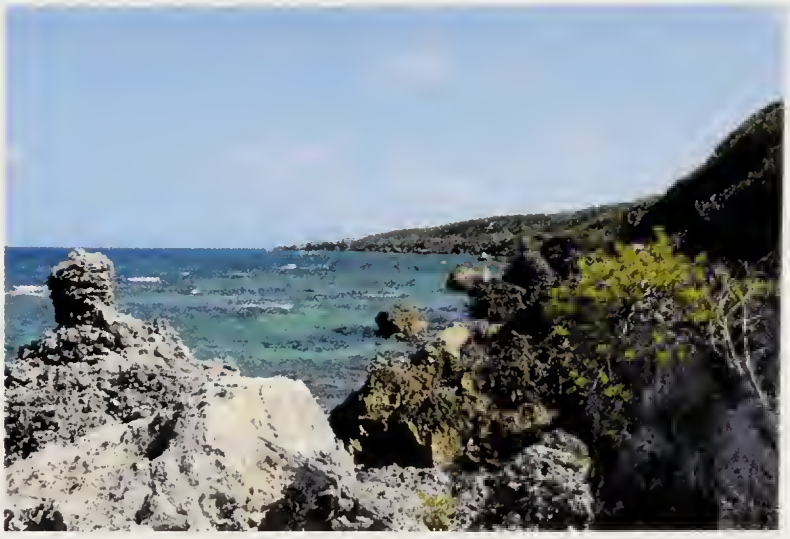


Figure 8. North-central coast of Little Swan Island showing the ragged cliffs and forests of that island. Photo taken on 12 December 2012 by L. V. O.

Sphaerodactylidae

Aristelliger nelsoni Barbour (1914)

This species is apparently being quickly replaced by the introduced gecko *H. frenatus*. This native and endemic *Aristelliger* (Fig. 12) proved difficult to find during our trip, but *H. frenatus* was extremely common in all parts of Big Swan, including nonedificarian forest types. We found one *A. nelsoni* inside a termite nest during the day (MCZ R-191121), one beneath tree bark during the day (MCZ R-191165), and two others (MCZ R-191071, 191146) were active on an old fence post at dusk. These two specimens were collected at the same time. Other crepuscular and nighttime searches did not reveal additional individuals. However, all walls associated with the naval base and previous structures left by the Americans were heavily populated with *H. frenatus* during the night. Clearly, *H. frenatus* is a serious threat to the native nocturnal and arboreal gecko fauna on Big Swan as well as the remainder of Honduras (McCranie, 2017). Barbour (1914) discussed the natural history of *A. nelsoni* from both Swan Islands on the basis of the collector's field notes of 1912 and wrote: "Mr. Nelson states that the species is extremely common on both Swan Islands. It is frequently

Figure 9. The authors on the left (J. R. M., L. V. O., A. H.) and the pilot gassing up the airplane to leave. Photo taken on 12 December 2012 by an unknown soldier.

heard croaking at dusk both among the coconut palms, in the houses (on [Big] Swan Island), and in the woods. On Little Swan Island the species occurs only in the jungle since this island is and always has been uninhabited and is without any cleared land." Those 1912 observations clearly contrast to what we found on Big Swan Island 100 years later.

Sphaerodactylus exsul Barbour (1914)

In December 2012, this tiny lizard (Fig. 13) endemic to the Swan Islands was common beneath ground debris on Big Swan and easily seen under leaves and loose rocks wherever forested areas occurred. Individuals of this diurnal *Sphaerodactylus* move rapidly when uncovered,

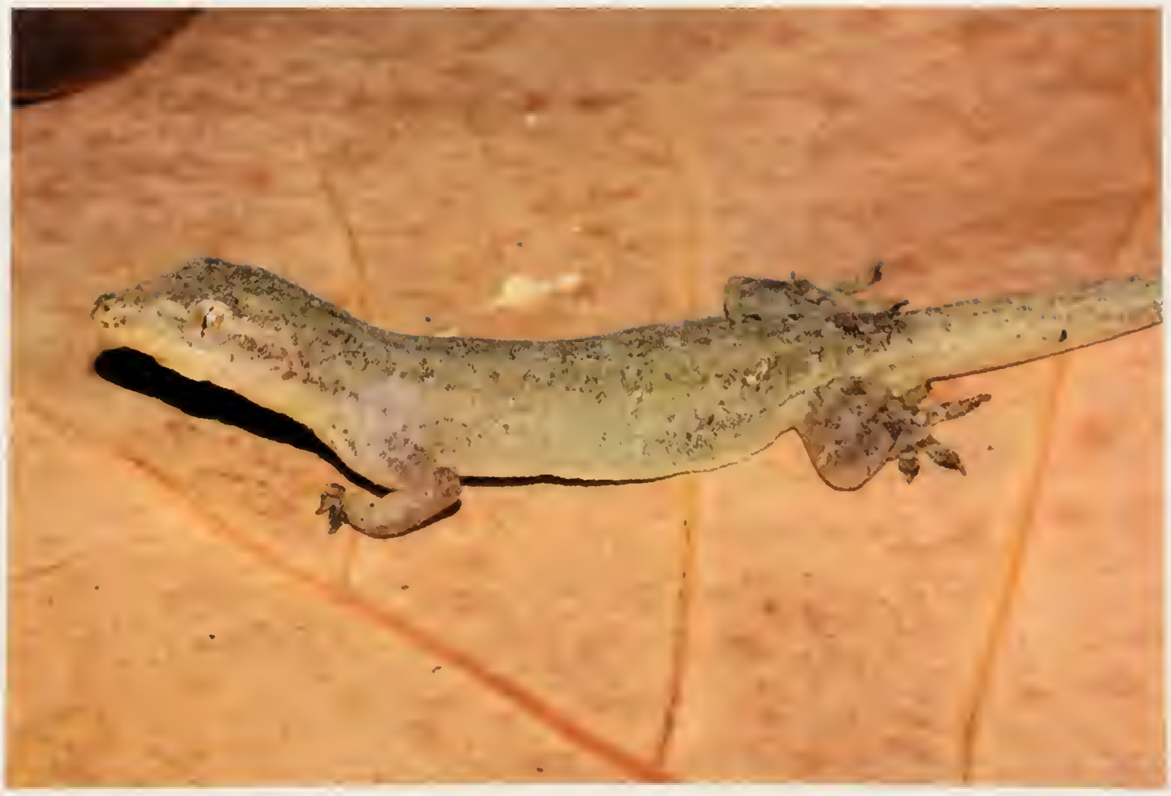


Figure 10. *Hemidactylus frenatus* (MCZ R-191070). Photo by J. R. M.

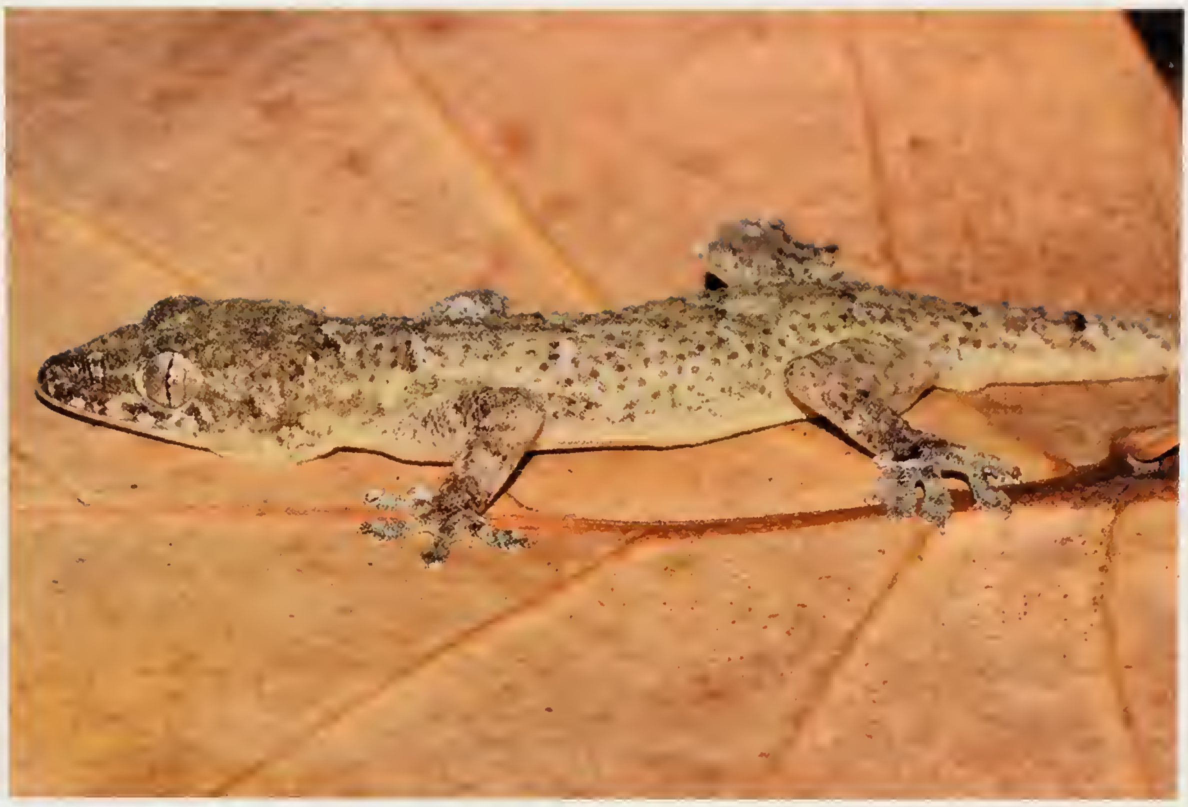


Figure 11. *Hemidactylus mabouia* (MCZ R-192116). Photo by J. R. M.

and are difficult to capture without damaging their fragile skin. This was an abundant lizard during 1912 (Barbour, 1914: 265) on Little Swan (also see Barbour, 1921: 256), but remarkably was not found on Big Swan at that time. Barbour (1914: 264–265) wrote: "Mr. Nelson says that these little lizards are very abundant in the accumulations of humus and fallen leaves in the cavities and depressions so very common in the sharply eroded aeolian limestone of the island." We collected a series on Big Swan Island (MCZ R-191069, 191089–92, 191125–26, 191142–45).

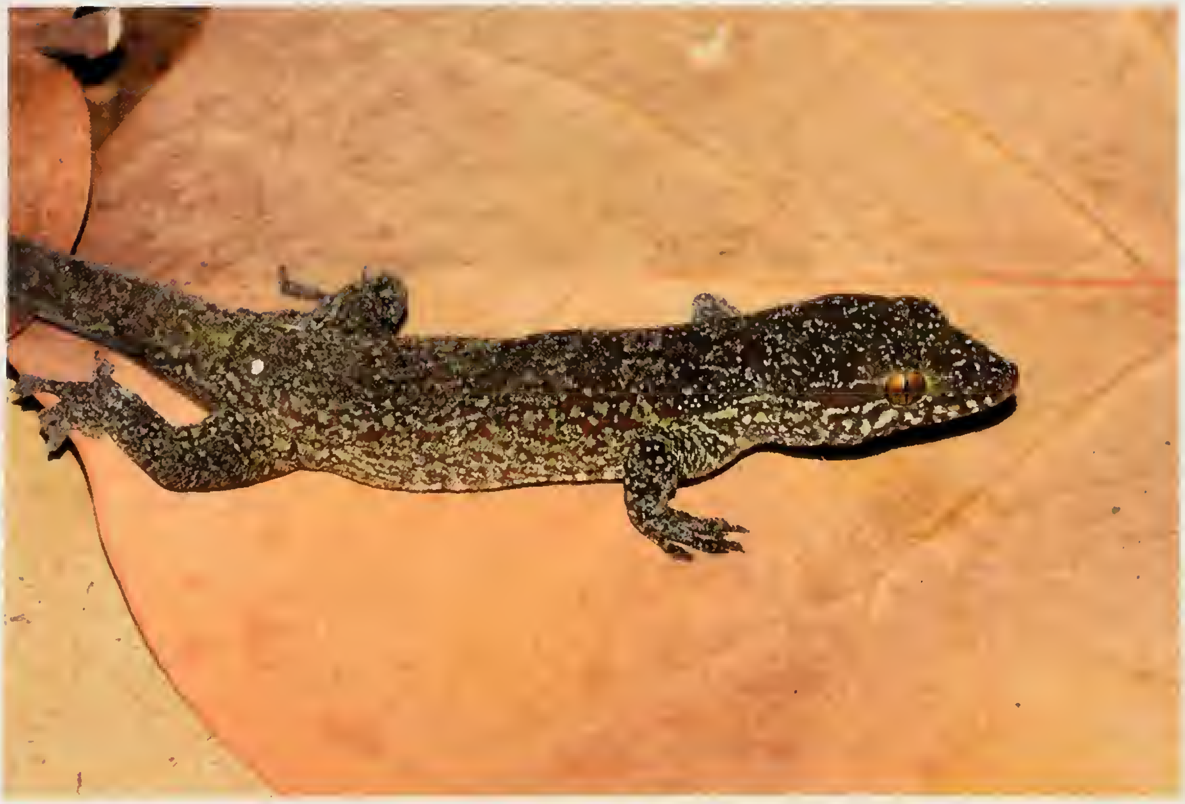


Figure 12. *Aristelliger nelsoni* (MCZ R-191146). Photo by J. R. M.

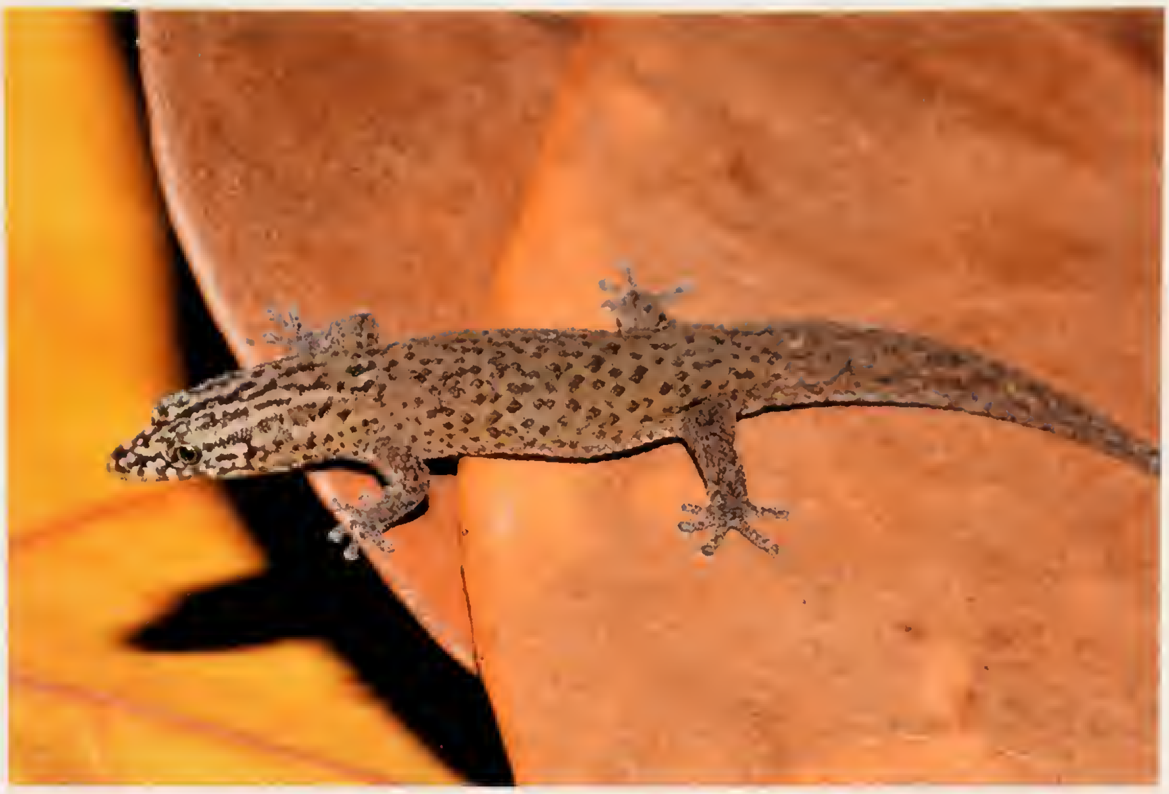


Figure 13. *Sphaerodactylus exsul* (MCZ R-191125). Photo by J. R. M.

Neoiguania
Dactyloidae

Norops nelsoni (Barbour, 1914)

The anoles of the Swan Islands are members of the *Norops sagrei* species complex. This anole is abundant on both Big and Little Swan islands, and occurs at the highest density of any lizard species J.R.M. has seen in all of Honduras. A.H. posted several discussions about this species on *Anole Annals* during 2013 (see Appendix). This anole was prominent in all forested and deforested areas on both islands. Everywhere one would sit down for a break, numerous individuals would appear within a few minutes. Barbour (1914: 287 from G. Nelson's 1912 field notes) called it "exceedingly abundant in all situations on both islands" during 1912. This has not changed during the subsequent 100 years.

The anoles on Big Swan Island (Figs. 14, 15) are similar in appearance to *N. sagrei* except notably larger, with a darker dewlap described as "deep olive-gray" (Barbour, 1914: 287; Ruibal, 1964: 493) or "burnt umber" to "clay color" (McCranie and Kohler, 2015: 116–117). Sexual dimorphism in this species is very pronounced, possibly as a consequence of ecological release in a population with no anoline competitors (Lister, 1976a, 1976b). On average, the males we measured had a snout–vent length (SVL) of 71.2 mm (SD of ±4.9) and a mass of 8.3 g (±2.1) and females were 52.4 mm (±3.4) and 2.9 g (±0.6), respectively.

The anoles on Big Swan Island were found in a wide range of habitats. Males were found primarily on tree trunks and branches (32/33 observations), whereas females used a wider range of substrates, including trunks and branches (27/38), the ground (6/38), man-made wood and metal posts (3/38), rocks (1/38), and leaves (1/38). Males were found at an average height of 94 cm (±48) on perches averaging 8 cm (±4) in diameter. Females used perches averaging 51 cm (±39) above the ground, with a diameter of 8 cm (±7). Most animals were observed in full or partial shade: 20/33 males and 25/38 females were in full shade, whereas 12/33 males and 10/38 females were in partial shade, and only 1/33 males and 3/38 females were in full sunlight. This

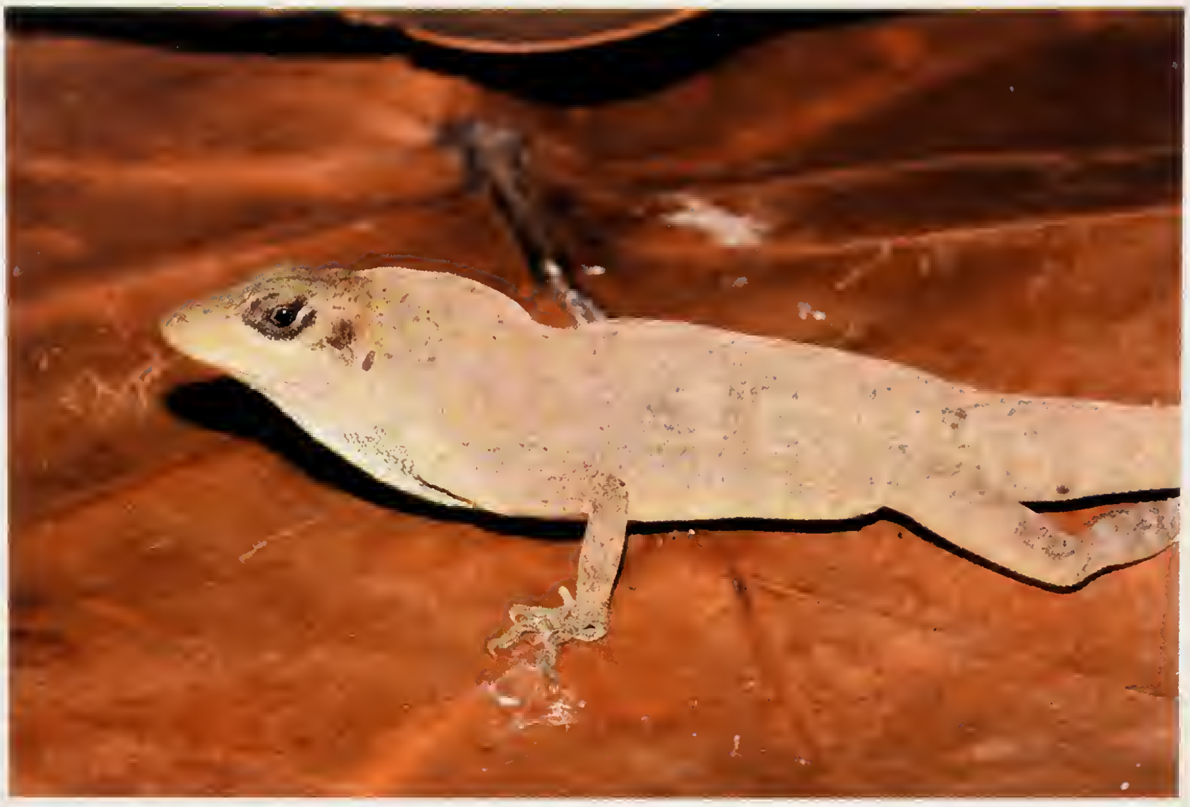


Figure 14. Adult male *Norops nelsoni* from Big Swan Island (MCZ R-192108). Photo by J. R. M.

preference for shade corresponded to an average of 97% (±5) canopy cover for males and 95% (±16) for females. A series was collected on Big Swan for future taxonomic study (MCZ R-192031–42, 192059–79, 192108–12, 192114).

Both males and females on Big Swan Island were most frequently observed perched with their head oriented toward the ground (18/20 and 14/20 observations, respectively). When approached, both males and females tended to flee up into the canopy (16/18 and 14/16 observations, respectively). This species appears to conform to a trunk–ground ecomorph in most respects, but the tendency to flee upward

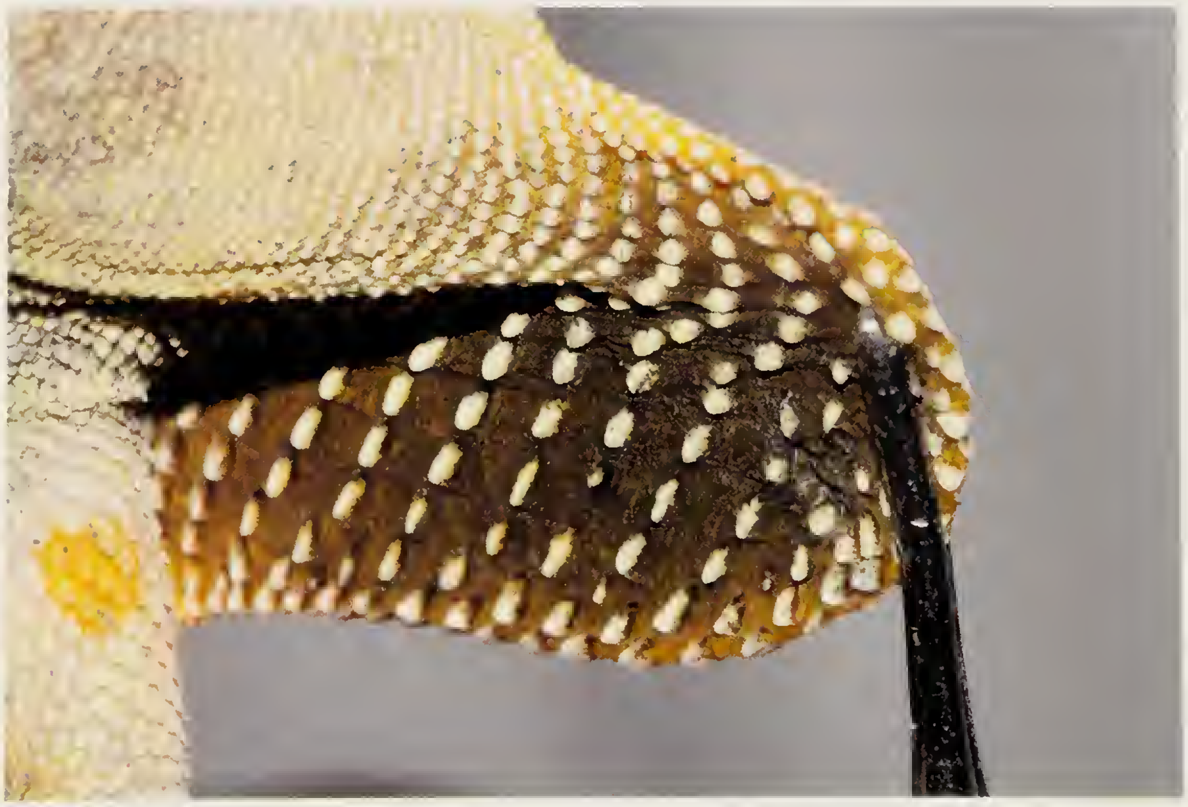


Figure 15. Adult male dewlap of *Norops nelsoni* from Big Swan Island (MCZ R-192114). Photo by J. R. M.

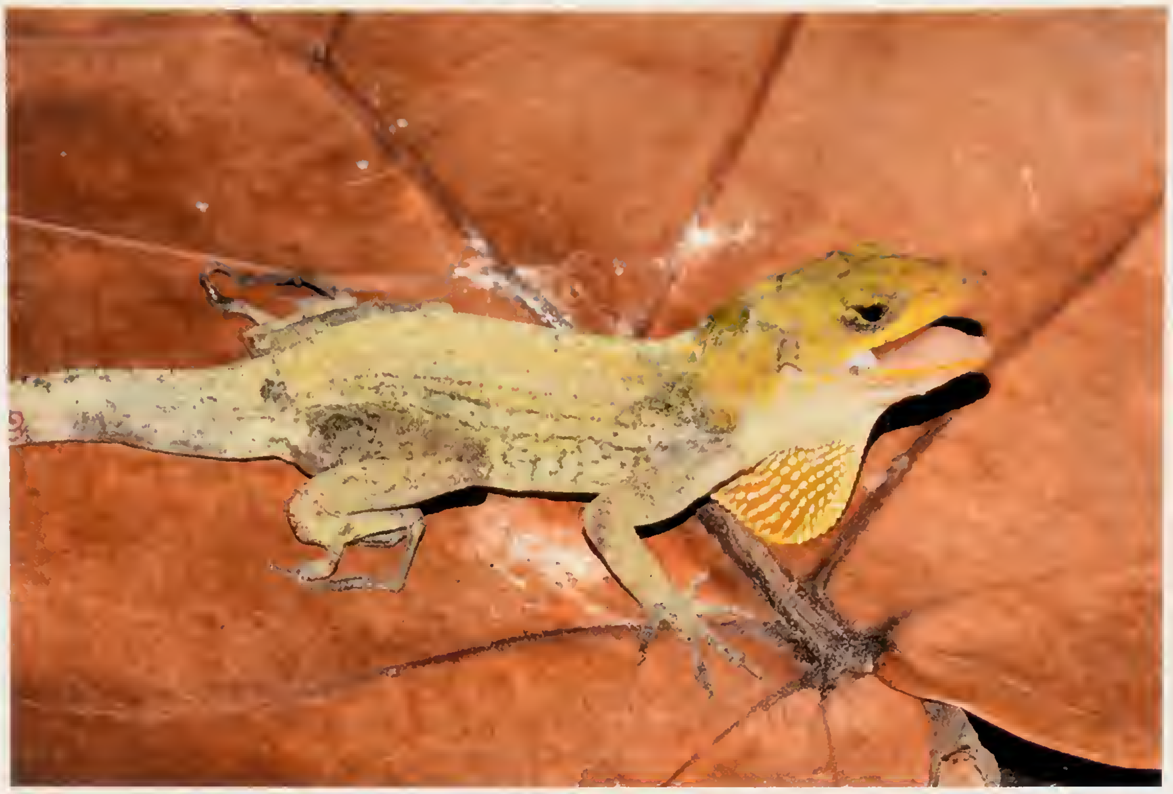


Figure 16. Adult male and dewlap of *Norops nelsoni* from Little Swan Island (MCZ R-194190). Photo by J. R. M.

into the canopy is more typical of trunk–crown anoles (e.g., Williams, 1972, 1983).

The *N. nelsoni* collected on Little Swan Island (Figs. 16, 17) had very distinctive coloration in life relative to the anoles on Big Swan. Male dewlap coloration was less dark with more yellow-orange tones. Another striking difference was the presence of vivid yellow and green longitudinal stripes and reticulations against a dark background on the bodies of males, compared with solid body coloration in males on Big Swan. The most striking difference, however, was the yellow pigmentation of the heads of both

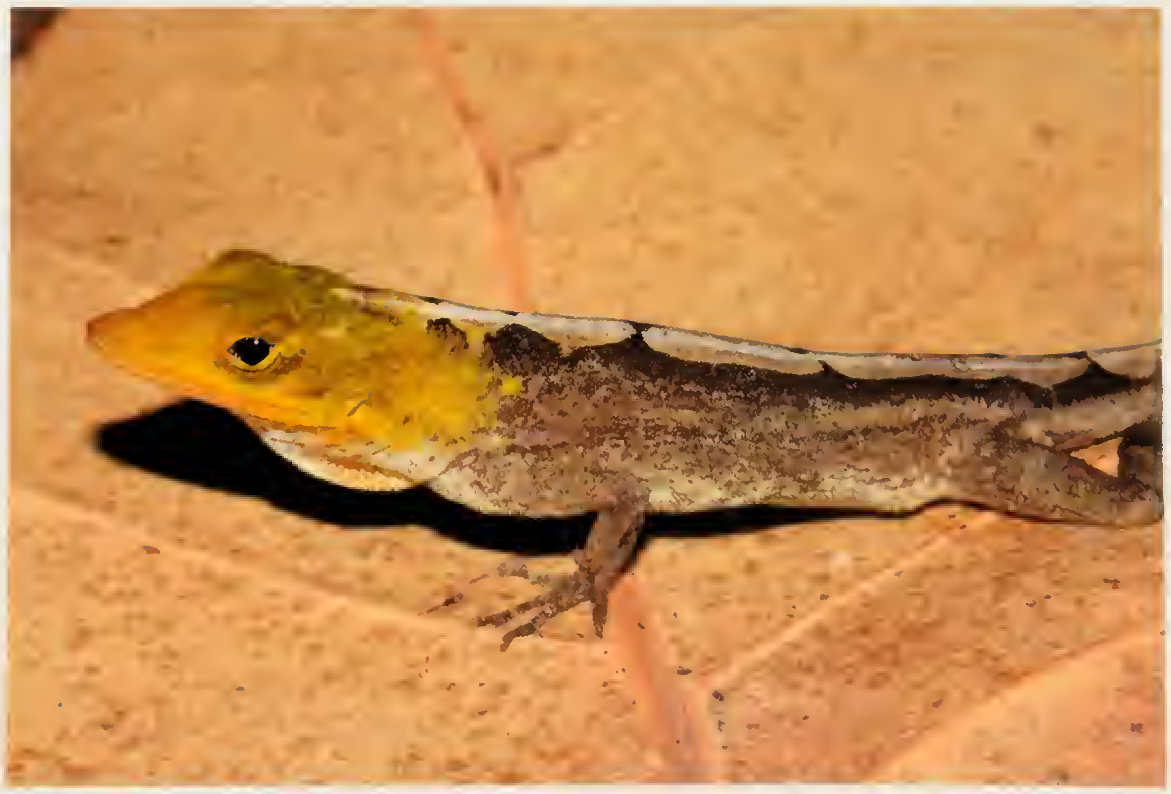


Figure 17. Adult female of *Norops nelsoni* from Little Swan Island (MCZ R-194191). Photo by J. R. M.

sexes on Little Swan, though somewhat more prominent in the females. Both males and females on Big Swan lacked yellow heads. The anoles of Little Swan were also smaller, on average, than the anoles of Big Swan: males averaged 65.2 mm (±7.6) SVL and 5.3 g (±1.6) mass, and females 50.9 mm (±1.6) SVL and 2.2 g (±0.3) mass. Males from Little Swan were significantly smaller than males from Big Swan with respect to both SVL ($t = -2.8$, $df = 22.5$, $p = 0.010$) and body mass ($t = -5.2$, $df = 38.1$, $p < 0.001$). Females also differed significantly in mass ($t = -3.4$, $df = 17.8$, $p = 0.003$), but not in SVL ($t = -1.6796$, $df = 8.341$, $p = 0.130$). A series of Little Swan anoles was also collected (MCZ R-192043–58, 192091–92, 192113, 194190–91).

Given the differences in coloration and size between the anoles of Big and Little Swan islands, the results of future work on genetic differences between these two populations and others in the *N. sagrei* species complex will be interesting. Might two populations in such proximity and so isolated from the rest of the Caribbean have diverged enough to merit status as a distinct species or as two distinct species? The data we were able to collect in our short time on the islands are insufficient to answer this question, but they do suggest that there might be an interesting evolutionary story hidden there.

Iguanidae

Iguana iguana (Linnaeus, 1758)

This iguana was still common on the rocky cliffs on Big Swan near the sea during 2012, even though it is regularly and illegally collected for its meat and eggs by nonregulated lobster fisherman that frequently visit the Swan Islands. J.R.M. watched, with binoculars, adult *Iguana* voluntarily entering the shallow marine waters near those cliffs and appearing to enjoy passively floating in the shallow, calm seawaters. A. H. also observed *Iguana* diving into the ocean when approached. *Iguana* was also common in forested areas of Big Swan and was regularly seen in open areas around the naval base and associated old structures left by the Americans. Barbour (1914) reported this iguana from "Swan Island" (as *I. delicatissima* Laurenti, 1768), but gave no habitat information. Moyne (1938: 82) stated "Land iguanas are far more numerous than I have ever seen them [on the Swan Islands], even on Galapagos, and are so indifferent to human approach that they can easily be seized by the tail." Lowe (1911) and Moyne (1938) provided photographs of Swan Island *Iguana* in their natural habitats. Because of their Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) classification, and our lack of permits, the geographic origin of these iguanas could not be studied using molecular methods.

Leiocephalidae

Leiocephalus varius Garman (1887)

This species (Fig. 18) appears to be a rather recent introduction to Big Swan Island from the Cayman Islands. It was first reported from "Swan Islands" by Schwartz and Thomas (1975: 128), who called it *Leiocephalus carinatus varius* (McCranie, 2017 suggested elevating *L. varius* to the species level). *Leiocephalus varius* is otherwise endemic to Grand Cayman Island. The first individuals to collect this species on the Swan Islands were two researchers from the Smithsonian Institution, Washington, DC in February 1974 (USNM 494801–08, 570244). Ferrari, in Sandoval et al. (2007), reported this population as "*Sceloporus* spp." Individuals of *Leiocephalus* on Big Swan show little fear of humans, even to the extent that, in J. R. M.'s opinion, a person had to step over a lizard for fear of stepping on it while walking around the naval base.

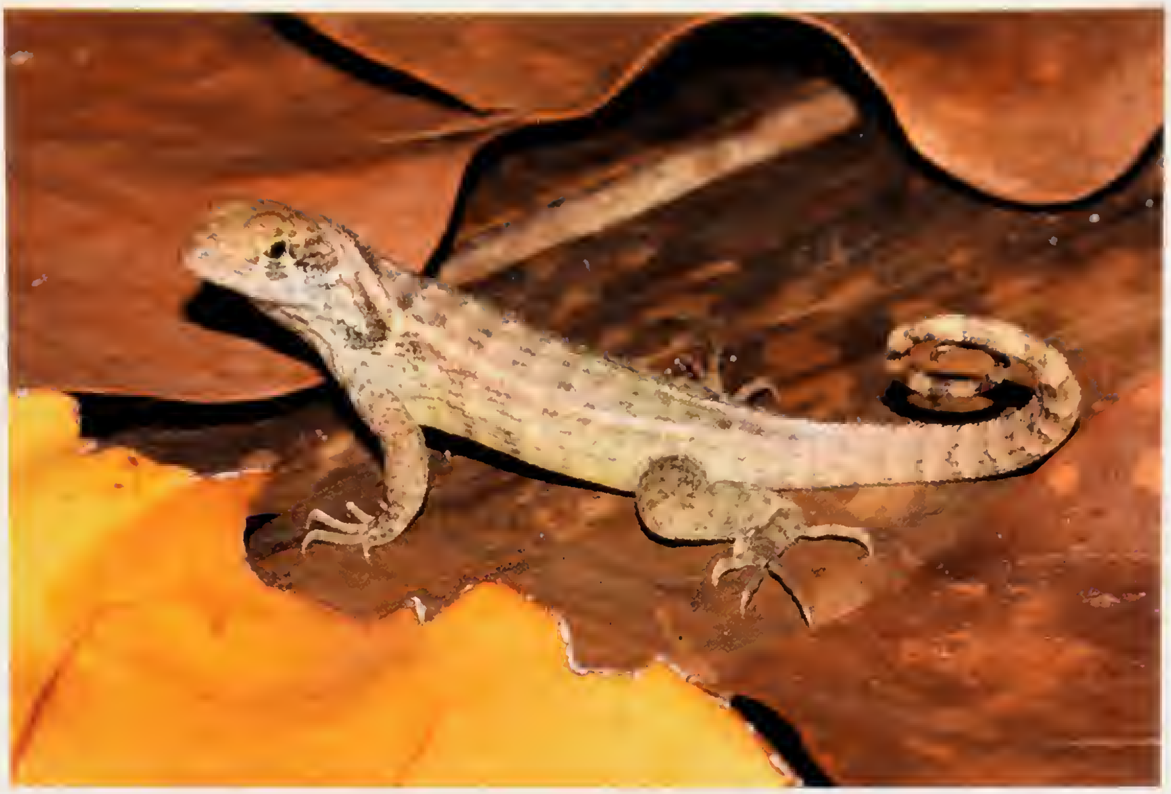


Figure 18. *Leiocephalus varius* (MCZ R-191123). Photo by J. R. M.

These lizards also freely moved in and out of occupied buildings of the naval base without showing concern for the humans in the buildings. They are abundant on Big Swan in both edificarian and nonedificarian open and forested situations. We did not see any of these lizards, which are so obvious on Big Swan, on our short time on Little Swan Island. Several Big Swan specimens were collected (MCZ R-191072, 191122–23, 191131–35, 191137–39, 191155–64).

Teiformata
Teiidae

Ameiva fuliginosa (Cope, 1892)

McCranie and Gotte (2015) discussed the collecting history and taxonomic status of this species, which was apparently long ago extirpated from the Swan Islands. We did not see any evidence of its occurrence on the Swan Islands in December 2012. Fortunately, a population of what is apparently this species still occurs on Isla de Providencia, Colombia (see Fig. 6 and front cover illustration in McCranie and Gotte, 2015).

Snakes

Alethinophidia
Dipsadidae

Cubophis brooksi (Barbour, 1914)

This snake is endemic to Little Swan Island, where it remains rarely collected. McCranie (2011) could only find five specimens (all females) in all the museums where he examined Honduran snake collections. However, Moyne (1938: 84) stated that they "caught several black snakes (*Alsophis angulifer brooksi*)" on Little Swan and placed them in the Natural History Museum, London (BMNH) collection. J. R. M. did not examine those specimens for his 2011 work. We did not see *Cubophis* on our one morning on Little Swan Island. Two researchers from the Smithsonian Institution, Washington, spent 2 days on Little Swan Island during February 1974, also without collecting a *Cubophis*. Curiously, Barbour (1914) did not report any field notes on *Cubophis* from G. Nelson, the collector of the type series. McCranie (2011) reported that one adult female (UNAH 3839) was stretched

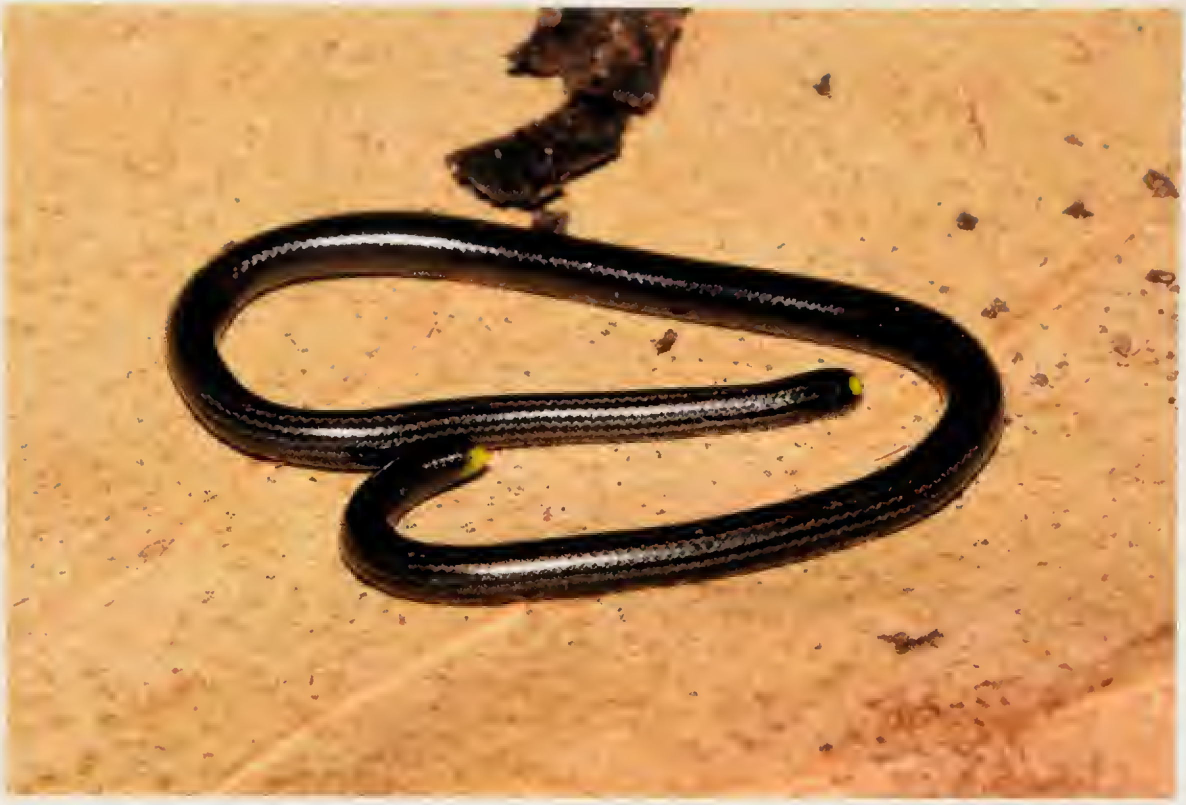


Figure 19. *Epictia magnamaculata* (MCZ R-191117). Photo by J. R. M.

out on a tree root in a limestone rock hole in May 1997.

Scolecophidia
Leptotyphlopidae

Epictia magnamaculata (Taylor, 1940)

This threadsnake (Fig. 19) appears common in termite nests on Big Swan Island (MCZ R-192117–19), but we did not see any *Epictia* in any other habitats. A concern for this tiny snake on Big Swan is that personnel from the naval base would make daily collections of five to six termite nests to burn in their sleeping quarters in an effort to drive out mosquitos. This daily event is certainly killing numerous individuals of this tiny *Epictia*. McCranie and Hedges (2016) provided morphological and molecular data demonstrating that *E. magnamaculata* is the correct name for the *Epictia* on the Swan Islands. McCranie (2011) had previously identified the Swan Island population as *E. magnamaculata* solely on the basis of morphological data. This species is restricted to and occurs on many Caribbean islands throughout its large geographical distribution (McCranie and Hedges, 2016); thus, it has a unique geographical distributional pattern among all reptiles. Barbour (1914: 324) reported this species from the Swan Islands (as *Leptotyphlops albifrons* [Wagler, 1824]), where it was "common there and found in the leaf mould of the forest" and that "it is often seen in broad day light crawling about in paths and clearings" (from G. Nelson's 1912 field notes).

Turtles

Cryptodira
Cheloniidae

Caretta caretta (Linnaeus, 1758 [in part])

The neurocranium of a *Caretta* from Big Swan Island is in the USNM collection (USNM 220768) and Lowe (1911, as *Thallassochelys caretta*) provided a photograph of a *Caretta* possibly from the Swan Islands (see Lowe, 1911: 32). Lowe (1911) also reported that this sea turtle occasionally nested on Big Swan. We did not see this turtle during our trip. Two elder, longtime residents of Guanaja Island (the closest land area to the Swan Islands) in the Honduran Bay Islands told J.R.M. (September 2012) that this species is now rarely seen in that

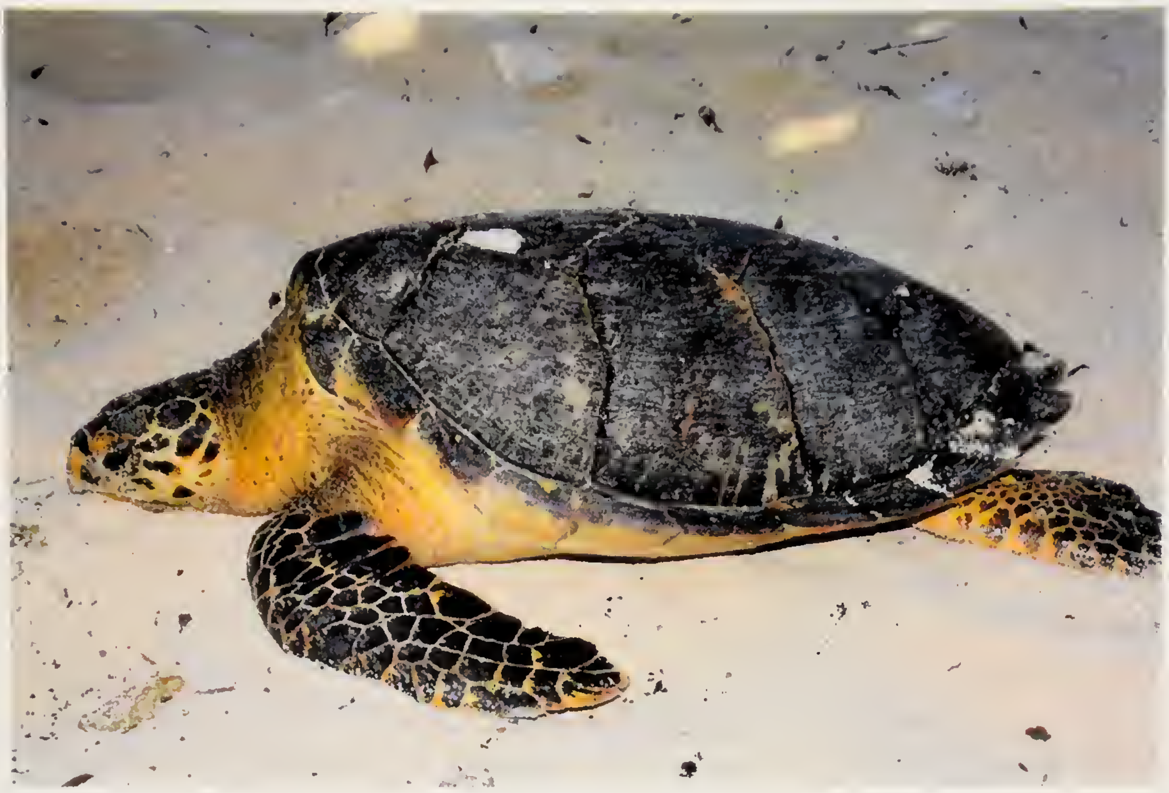


Figure 20. *Eretmochelys imbricata* from offshore of Big Swan Island. Photo by J. R. M.

area compared with when they were young men. We suggest that *C. caretta* has also decreased in abundance around the Swan Islands.

Chelonia mydas (Linnaeus, 1758 [in part])

Lowe (1911, as *Chelone midas*) mentioned that this marine turtle occasionally nested on Big Swan Island. We did not get a glimpse of this marine turtle on our visit, and as far as we can tell, no Swan Island specimens exist in any museum.

Eretmochelys imbricata (Linnaeus, 1766 [in part])

Lowe (1911) also wrote that this marine turtle occasionally nested on Big Swan Island. A diver from the lobster boat that took us to Little Swan Island caught an adult female *Eretmochelys* and gave it to us to photograph (Fig. 20). He caught the turtle on the sea bottom next to a coral reef off the northeastern shore of Big Swan Island.

DISCUSSION

Our update of the reptile fauna of the Swan Islands demonstrates the importance of author(s) of a faunal list having first-hand field experience with the species and area about which they are writing. All previous species lists on the Swan Island reptiles were by author(s) with no personal experience on these islands. Only Lister (1976a,1976b), however, did base his study of niche expansion in anoles on field observations conducted on Big Swan. Therefore, species list and field notes in this article are the first ever published by authors who have done fieldwork on the species on this list.

Our natural history observations, mostly on Big Swan Island, indicate that many changes in the island's reptilian fauna and the abundance of some species have occurred between 1912 and 2012. Two of the four Swan Island endemic reptilian species (*S. exsul*, *N. nelsoni*) appear to remain as common today as in 1912. One species (*Aristelliger nelsoni*) currently has drastically lower population numbers than during 1912, and another species (*Cubophis brooksi*) remains as poorly known now as it was during 1912. Three introduced lizard species that were not present during 1912 currently occur on the islands (*H. frenatus*, *H. mabouia*, *Leiocephalus varius*). The populations of *H. frenatus* have apparently driven the formerly "extremely common" *A. nelsoni* populations to the brink of extinction. Another change over the past century is that *S. exsul* was not found on Big Swan Island in 1912, but was present in a 1974 survey by the Smithsonian Institution (USNM 494672–76, 494678–748), and was common on that island during our 2012 visit.

As in all other parts of Honduras, the Honduran governmental agency (ICF; Instituto Nacional de Conservación y Desarrollo Forestal, Áreas Protegidas y Vida Silvestre, Tegucigalpa) assigned with protecting the country's natural resources has shown no interest in helping protect those natural resources on the Swan Islands. Two things those ICF personnel should do is implement a plan to eradicate the feral cat population on Big Swan Island, and to act toward having those naval base personnel restrict access to both islands by lobster fishermen whose main purpose in visiting the islands is to capture and kill the CITES-listed *Iguana* for a source of protein. All that inaction, despite the Swan Islands being designated as a Marine National Park (Reserva Marina Islas del Cisne; see Cruz, 2008), which also includes the land areas and their terrestrial-arboreal faunal residents. Therefore, although these islands are part of a national park (see McCranie, 2011, 2017; McCranie and Köhler, 2015), the park designation is in reality only a "paper park" in its truest meaning. "Natural resource protection" on Big Swan Island ostensibly comes from the Honduran Naval Base Headquarters that restricts access to that island, but apparently only to foreigners, including biologists wanting to study parts of that island's fauna. As a result of those lobster fishermen's illegal raids, the populations of *Iguana* on the islands can no longer be said to be "numerous" or "indifferent to human approach" as written by Moyne (1938: 82).

Natural resources protection on Little Swan Island comes from the island itself. Little Swan Island consists of forested, ragged-edged cliffs that entirely cover the island, leaving it difficult to access and unfit for human habitation and domesticated livestock. Its topography also makes Little Swan Island unsuitable for agriculture. The two islands' isolation is also helpful in deterring the harmful effects of tourism seen in many locations around the world. We hope that this isolation will be sufficient to protect the biodiversity remaining on these islands for future generations.

ACKNOWLEDGMENTS

Said Laínez and Iris Acosta of the ICF helped in the acquisition of permits (Resolución DE-MP-102–2012) to collect and export reptiles from the Swan Islands. We thank the lawyers Antonio Valdés Paz and Silvia Judith Orellana Flores for their enormous help in acquiring permits from the Honduran Naval Base Headquarters in Tegucigalpa, allowing us to visit and work on the Swan Islands. Jonathan Losos (MCZ) was extremely helpful in acquiring a grant from the Barbour Fund to largely finance our 2012 trip. Ronald Crombie also shared with J. R. M. some of his experiences on these islands, especially providing information on Little Swan Island. Joseph Martinez (MCZ) provided information on some of the specimens in the MCZ collection.

APPENDIX

The following material was posted by Alexis Harrison on the website *Anole Annals* (http://www.anoleannals.org/) and is reprinted here with some material omitted.

The Swan Islands, three tiny outcroppings of petrified reef jutting out of the otherwise open stretch of water between Cuba, the Cayman Islands, and Honduras, hold one of the least-known populations of *Anolis* in the Caribbean. A visit by George Nelson in 1912 established that anoles are present on both the larger Great Swan Island (larger is a relative term—the entire island is about 5.5 km^2) and Little Swan (which is about half that size). The specimens collected by Nelson were later examined by Barbour at the Museum of Comparative Zoology at Harvard and found to be closely related to *A. sagrei*—they were designated as a species, *A. nelsoni*, notable mainly for its exceptionally large size. They were later relegated to a subspecies of *A. sagrei* by Ruibal.

Aside from a visit by Brad Lister in the early 1970s, the anoles of the Swan Islands have been left in relative peace by anolologists. That is, until last December, when I joined a team including Jonathan Losos, Randy McCranie, and Leo Valdes Orellana that set out to visit the Swan Islands to learn more about this mysterious member of the anole clan.

Getting to the Swan Islands turns out to be much easier said than done. The island has been uninhabited for decades, except for a handful of rotating members of the Honduran Navy who are stationed there to keep drug smugglers from using the island as a way station. The only way to contact the island is by radio, with the cooperation of the Honduran Navy. The only way to reach the island is by chartering a private plane or boat. And getting permission to fly there required a week of wrangling with the authorities in La Ceiba, Honduras. With the help of local contacts in the police and the intervention of a lawyer, we were ultimately able to get the necessary permission, first from the head of the armed forces for all of Honduras, and then by the heads of the Air Force and the Navy, respectively. Once we had permission, we managed to charter a small plane to the island, stocked up on rice, beans, water, and batteries (the islands have no electricity or running water), and were ready to go (minus Jonathan, who couldn't last out the wait for permits and had to return to the U.S. to grade final papers.

Big Swan Island

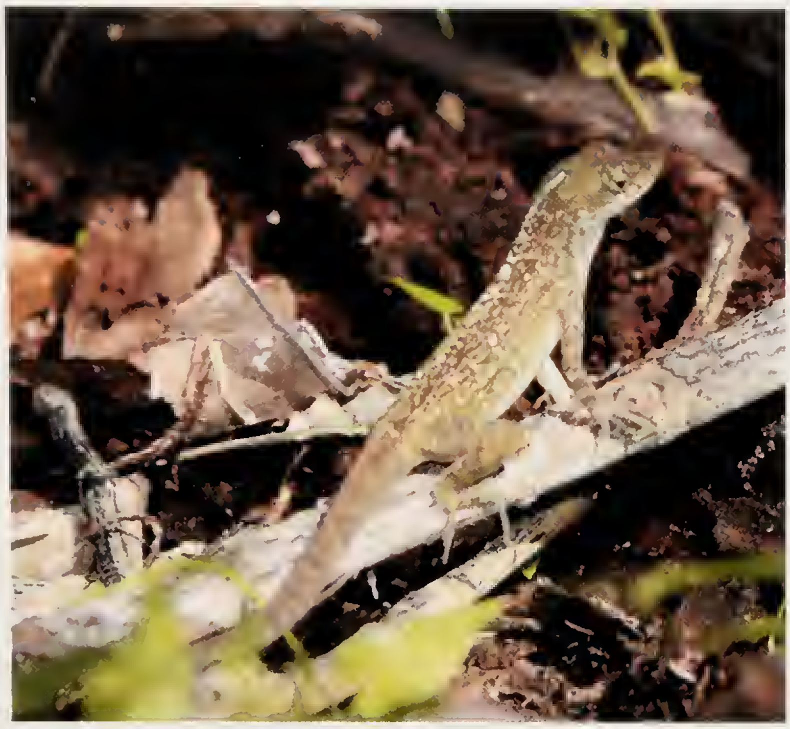
Swan Island from the Air. Photo by Alexis Harrison.

Our first view of the island from the air revealed rugged cliffs and open beaches, dense forest, and decaying buildings overgrown by vegetation. We landed on the grassy runway that dominates at least a quarter of the area of the larger island and were greeted by seven armed members of the Honduran Navy and one friendly dog. Despite the guns, the Navy was very welcoming and helpfully carried many of our supplies to the main camp, where they had barracks and a kitchen, and where we could work at an indoor picnic table and could pitch our tents. After some minimal unpacking and setting up, we set off to get a feel for the island.

The forests in the center of the island are dark and dense. Walking short distances takes a long time, as you weave through interlaced branches, vines, and spider webs. The occasional clearing is full of thick, flourishing vegetation, sometimes innocuous vines covered in purple flowers, sometimes with feathery vines hiding needle-sharp hooked thorns. Later, when my arms and legs started to swell with painful blisters, I realized that the forests were also seeded with poisonwood.

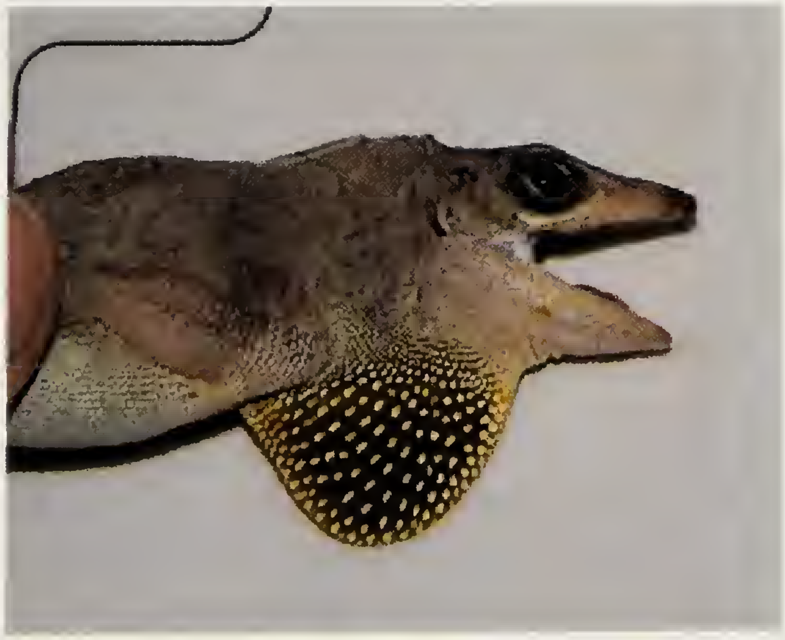
The edges of the island alternate between crumbling jagged cliffs and empty stretches of beach. The cliffs housed resident populations of green iguanas, in much greater numbers than in the interior of the island. When approached, these grizzled creatures did not hesitate to dive into the ocean and to swim underwater away from the shore. The iguanas shared the shore with abundant curly-tailed lizards, who also occurred anywhere on the island where there was a break in the vegetation. The island is also home to an endemic species of agouti (I saw these shy rodents twice, while sitting quietly observing the behavior of anoles) and a large nesting population of brown boobies. Magnificent frigatebirds often flew overhead, but never seemed to get too close to the land.

Unfortunately, several introduced species have also gained a toehold here. I saw rats running through the brush around the buildings a couple times. My companions observed several cats prowling the area at night. And the walls of the buildings seemed to hold an endless supply of house geckos. It seemed, however, that all of these species were less common in the island's interior.



Anolis sagrei nelsoni from Great Swan Island. Photo by Alexis Harrison.

In a previous post, I detailed the trip to Swan Island and our initial impressions. But now for the important stuff. The most abundant animals on the island were the anoles. They could be found on the beach, in the forest, on the buildings, on the hammock where we napped in the hottest part of the afternoon. This abundance was not immediately apparent, as the anoles seemed rather shy and tended to hide when I approached. Yet, if I sat still for a few minutes, anoles would start descending from the treetops and soon there seemed to be an anole on every branch.



Dewlap of A. sagrei nelsoni from Great Swan Island. Photo by Alexis Harrison.

My immediate impression was that these anoles did not "feel" like typical *A. sagrei*. They were light in coloration when calm, more like *A. cristatellus* than *A. sagrei*. Their eyes were marked like *A. sagrei*, but they were larger and darker. Females seemed similar in size to *A. sagrei* that I have seen elsewhere, but the males were (much) larger. This pronounced sexual dimorphism is consistent with the pattern in the anoles of the Lesser Antilles, where sexual dimorphism is exaggerated on single-species islands. Finally, the dewlap of the anoles on Swan Island were much darker than what I think of as typical *A. sagrei* dewlaps, and did not have the typical two distinctive colors, red and yellow, but graded from a lighter margin to a darker center gradually.

The anoles on Swan Island were also different from "typical" *A. sagrei* in their behavior. My general impression was that they were more shy of people. When threatened, they nearly always ran up into the canopy, rather than toward the ground or around their perch. Males displayed their dewlaps relatively infrequently. Finally, I observed them using a broad range of perches. Males especially used broad horizontal perches in the canopy of trees in addition to lower vertical perches.

My first two posts reported on how we got to the Swan Islands and what we found on Great Swan, especially the anoles. But after 5 days on the island, we had given up hope of crossing the strait to Little Swan Island. The navy on the island had no boat. The channel between the islands, although narrow, was deep and carried a substantial current. From the air, it appeared that there were no sandy beaches on which to land, only jagged rocks beyond the jagged reef.

That afternoon, we were surprised to hear the sound of a motor. From the top of the dilapidated radio tower, someone spotted a small boat headed for the island. It turned out to be a lobster boat, headed back to the mainland of Honduras after several weeks collecting lobsters offshore. They were stopping at Swan Island to replenish their supply of plantains and rainwater. With a little haggling, we were able to persuade the captain to ferry us over to Little Swan the next day and pick us up again several hours later!

Heading to the Lobster Boat

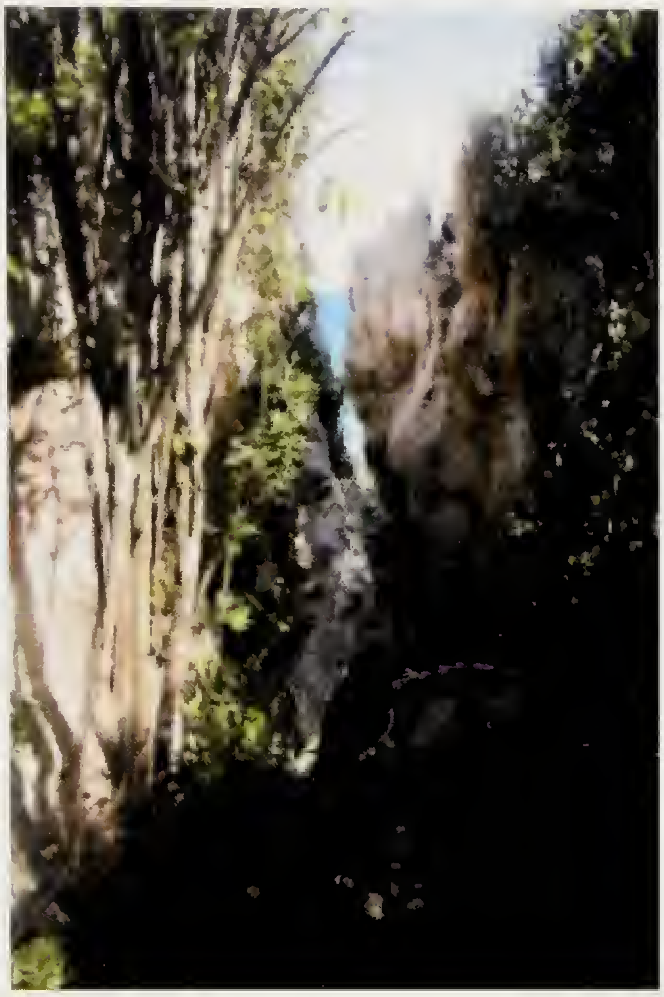
We arranged to leave the next morning at 6 a.m. The morning came and we packed our gear and went to wait at the dock. Two men headed from the boat to the shore in rickety-looking fiberglass canoes and we piled in: three in one canoe and two in the other. Randy and I were sitting in the canoe with three and I was a little nervous. The lip of the canoe seemed awfully close to the water line and the surf was high enough to bounce us around. But the sailor paddling us back seemed unconcerned, so away we went.

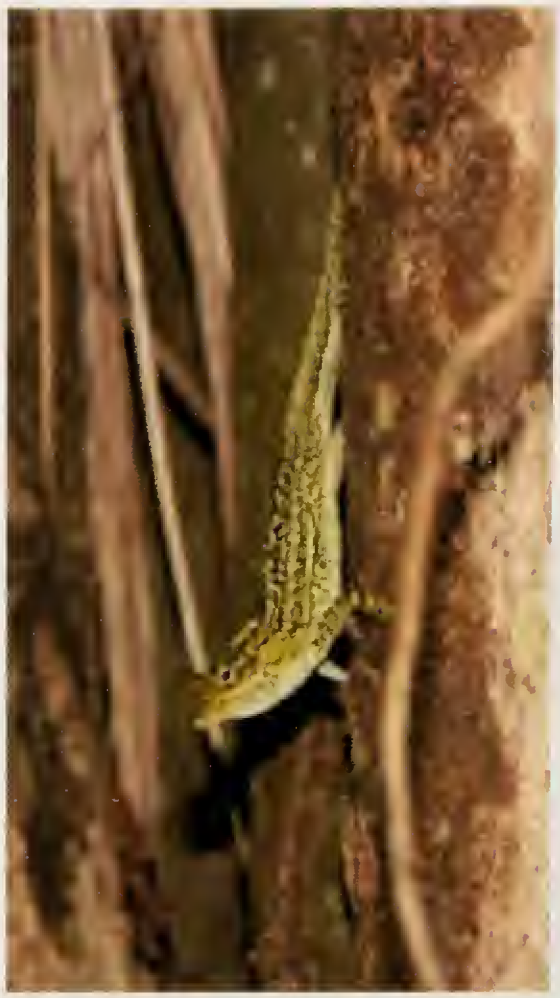
We made it about halfway to the boat before a wave came up to the lip of the canoe and poured in. Within moments the canoe had disappeared beneath us and we were bobbing in the water a couple hundred feet from shore. My first thought was that my camera was going to get wet; the second thought was that it is hard to tread water in hiking boots. I tried to hold my backpack over the water while we waited for the second canoe to come over. I was able to toss my bag into the canoe, then we held on to the side of the canoe and were towed back to the shore. The other canoe and Randy's rake stayed on the bottom of the ocean.

Our next attempt to reach the boat was successful. This time, we used three canoes. The captain of the boat was also able to find three life jackets to send along, just in case.

The crew of the boat was packing up their hammocks when we came aboard. The boat was small—perhaps 50 feet in length—but it housed dozens of men. I couldn't count them all. There were definitely over 30. They were seated on the stowed canoes, on the floor, and on the stacks of oxygen tanks that lined the deck. I gathered that they were employed in diving to collect lobster by hand. They were curious and hospitable, and offered us coffee and breakfast while we chugged over toward Little Swan.

When we reached the edge of the reef that surrounds Little Swan, we once again climbed into canoes (with life jackets!) and started paddling toward shore. We had to paddle around a bit to find an opening in the reef so we could get close to the shore. And we got a bit wet again at the shore, where the only option was to jump out and scramble up jumbled boulders. But we made it! The search for more reptiles and amphibians commenced.





Anolis sagrei nelsoni on Little Swan Island. Photo by Alexis Harrison

Little Swan seemed much like Big Swan, except perhaps more rugged and difficult to navigate. Great gashes in the rock necessitated frequent climbing, in and out of small gardens where detritus had gathered and lovely trees had taken root. These cool retreats were where I found the anoles of Little Swan.

And what anoles they were! Shockingly colored with bright yellow-blue stripes running the length of their body. Like the anoles of Great Swan, they were large and highly dimorphic. Unlike the anoles of Great Swan, they were found on rocks and tended to run down into cracks in the rocks to hide, not up. They were less shy and easier to catch than the anoles on Great Swan. Their dewlaps were also different in coloration: they were a solid light yellow-orange studded with light scales. I had less opportunity to observe these anoles, since our time on Little Swan was limited and the priority was collecting. However, I am quite convinced that the populations on the two islands are distinct enough that I could easily tell on sight from which island an individual originated.

Photo by Alexis Harrison.

Bag o' Iguanas.

After 6 hours exploring Little Swan, the boat returned as promised and we gathered on the rocks to wait for our canoes. We made it to the boat without incident and with a great feeling of accomplishment and also pleasant fatigue and hunger. The cook presented us with a gourmet lunch of fried lobster and rice, and the crew brought out a sea turtle they had captured for us to see. They had also collected a sack of green iguanas somewhere along the way, and they were being butchered in the back of the boat, presumably for dinner. When we left the boat to return to Big Swan, I was presented with a plastic bag full of lobster tails on ice for us to eat for our dinner. It was the most delicious food I could remember eating in ages.

Heading Home

The time to depart arrived but the pilot did not. Our bags were packed; specimens, both live and in formalin, were carefully stowed in bags within boxes and boxes within bags. We ate breakfast and began watching the sky for the plane. Ten o'clock a.m. arrived and no plane. Noon came and we ate lunch quickly in case we had to leave quickly. By 3:00 in the afternoon, we decided the pilot could not get us back before dark, and therefore wasn't coming. We had no way to contact the mainland and no way to know why the pilot had not appeared. Was it bad weather? Mechanical problems with the plane? Had he forgotten? The possibility of hitching a ride home on a fishing boat was discussed. I wondered where the sole woman on such a boat would go to the bathroom. We unpacked our sleeping bags and crossed our fingers.

Salvation!

The next morning was bright and clear, and we again ate breakfast and settled in to watch the sky to the west. Around 8:00 a.m. we heard the distant hum of a motor. A few minutes later the plane came into view! We carted out supplies to the airstrip, loaded up our supplies, and waved goodbye to the Swan Islands.

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Photo on the front cover:

Leiocephalus varius from Big Swan Island. Photo by James R. McCranie (J. R. M.)

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